growing a nitride layer during introduction of the nitrogen onto and in reaction with said GaAlAs-InGaAs layers making the interface between said contamination free facet surface and said nitride layer gradual, said nitride layer gradually making use of a native nitridisation in order to obtain a gradual border line between said layers.--

B6 end

Add the following new claim:

--36. (new) The method of claim 2, wherein the substance used in the dry etching step comprises at least one substance selected from the group consisting of nitrogen; hydrogen; argon; Cl-, Br- and I-based compounds; CH_4; and C_2H_6.--

B7

Please charge the fee of $9 for the extra dependent claim added herewith, to Deposit Account No. 25-0120.

REMARKS

This application has been amended so as to place it in condition for allowance at the time of the next Official Action.

The Official Action objects to the specification and claims as to matters of form. Please note that applicants have amended the specification and claims as necessary in order to eliminate the bases for these objections, and reconsideration and withdrawal thereof are therefore respectfully requested.

Applicants note that in connection with claim 35, the recitation of "said nitride layer gradual" is believed to be appropriate, as this language concludes the passage "making the

interface between said contamination free facet surface and said nitride layer gradual".

The Official Action rejects claims 1, 2, 11, 12, 13, 23, 26, 32, and 33 under 35 USC §112, second paragraph, as being indefinite. Reconsideration and withdrawal of this rejection are respectfully requested for the following reasons:

Please note that applicants have amended the identified claims as necessary in order to eliminate the bases for this rejection.

The Official Action rejects claims 1, 2, and 9 under 35 USC §102(b) as being anticipated by CHAKRABARTI et al. 5,668,049. Reconsideration and withdrawal of this rejection are respectfully requested for the following reasons:

The Official Action identifies the text in the applied reference construed as disclosing each of the features recited in the rejected claims. The recited step of growing a native nitride layer on the mirror facets is considered to be disclosed by the CHAKRABARTI et al. step of depositing a SiN_x dielectric on the cleavage surface. However, the body upon which such dielectric layer is deposited is described not as comprising silicon, but rather as being made from GaAs. Accordingly, the SiN_x layer taught by CHAKRABARTI et al. cannot reasonably be construed as a native nitride layer, as it does not represent the nitriding of the GaAs layer, but rather the depositing of SiN_x.

As each of the rejected claims recites, either explicitly or implicitly, the step of growing a native nitride layer, the applied CHAKRABARTI et al. reference necessarily fails to disclose the full set of features recited in these claims.

The Official Action rejects claim 35 under 35 USC §102(b) as being anticipated by SUGIURA et al. 6,204,084. Reconsideration and withdrawal of this rejection are respectfully requested for the following reasons:

Claim 35 recites, among other features, the step of "growing a nitride layer during introduction of the nitrogen onto and in reaction with said GaAlAs-InGaAs layers" (emphasis added). In connection with this step, the Official Action identifies the text in column 21, lines 28-30. Applicants note, however, that the identified text in the reference states:

> The fourth embodiment is directed to a p-type GaAlN current injection layer 18 and a p-type GaN contact layer 19 which are formed by supplying plasmatic nitrogen using one of reduced-pressure CVD, photo-excited CVD and cracking methods in addition to the foregoing concrete example (first embodiment) of the present invention. (emphasis added).

Accordingly, the reference fails to disclose the step of introducing nitrogen onto and in reaction with GaAlAs-InGaAs. For at least this reason, the reference necessarily fails to anticipate the invention recited in the rejected claim.

The Official Action rejects claims 3-8 and 10-12 under 35 USC §103(a) as being unpatentable over CHAKRABARTI et al. in

view of SUGIURA et al. Reconsideration and withdrawal of this rejection are respectfully requested for the following reasons:

Applicants respectfully suggest that it would not be obvious to one of skill in the art to realize that an active layer, as taught by the prior art, could be replaced by a passive layer. There exists no source of motivation, identified or otherwise, for such replacement. The extrinsic coating of a layer according to CHAKRABARTI et al. is entirely different from that of the present invention. Accordingly, there remains no identified source for teaching that the layer could be created intrinsically, as in the present invention.

SUGIURA et al. provide no reason for one of skill in the art to search for a solution to the problems solved by the present invention. In this regard, the applied references, considered collectively, provide no indication of even the awareness of the problems solved by the present invention as claimed, let alone the solution therefor.

The Official Action rejects the following claims under 35 USC §103(a) as being unpatentable over the identified combination of references: claims 13-16 based on CHAKRABARTI et al. in view of HORIE et al. 6,323,052; claims 17-25 based on HORIE et al. in view of BELOUET et al. 5,780,120; and claims 26-34 based on SUGIURA et al. in view of BELOUET et al. Reconsideration and withdrawal of these rejections are respectfully requested for the following reasons:

The shortcomings of the CHAKRABARTI et al. have been addressed above in connection with the preceding anticipation and obviousness rejections. Furthermore, both BELOUET et al. and HORIE et al. disclose the creation of a surface which is cleaned by means of argon at low energy. After that, Gallium nitride (GaN) is coated onto a surface, whereby two separate steps are required. Therefore, both of the references are principally concerned with reducing radiation during cleaning by using low energy radiation. As compared with HORIE et al., the present invention reduces undesired recombination of charges via surface states, since no sharp interface is present, as in the prior art technology. On the contrary, the present invention provides for a gradually changing interface from one layer to the other.

The combination of SUGIURA et al. and BELOUET et al. has the same disadvantage as the other combinations of prior art documents, in that each requires two separate steps for cleaving and cleaning, as embodied in the requirement for a separate laser-based cleaning step.

In light of the amendments described above and the arguments offered in support thereof, applicants believe that the present application is in condition for allowance and an early indication of the same is respectfully requested.

If the Examiner has any questions or requires further clarification of any of the above points, the Examiner may

contact the undersigned attorney so that this application may continue to be expeditiously advanced.

Attached hereto is a marked-up version of the changes made to the specification and claims. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Respectfully submitted,

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April 23, 2003

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Page 9, the paragraph beginning on line 42 and bridging pages 9 and 10 has been amended as follows:

--The method according to the invention is to nitridise laser mirror facet of laser bars or laser chips during an etching process, such as milling with a gas comprising neutral nitrogen atoms or [nitorgen] nitrogen ions in molecular and/or atomic form in a vacuum chamber. The facets of the laser bars were first cleaved in air, or some other ambient atmosphere. Introduction of a reactive gas like nitrogen in the etching process will certainly affect the crystal surface properties since it reacts with the crystal elements and creates a nitrided surface layer.--

IN THE CLAIMS:

Claim 1 has been amended as follows:

--1. (amended) A method to obtain contamination free surfaces of a material chosen from the group [comprising] consisting of GaAs, GaAlAs, InGaAs, InGaAsP and InGaAs at crystal mirror facets for GaAs based laser cavities, comprising:

[•] cleaving out said crystal mirrors facets exposed to an ambient atmosphere containing a material from the group [comprising] consisting of air, dry air, or dry nitrogen ambients;

[•] removing any oxides and other foreign contaminants obtained during the ambient atmosphere exposure of the mirror facets by dry etching in vacuum;

[•] growing, after having the oxides removed, a native nitride layer on the mirror facets by treating them with nitrogen.--

Claim 2 has been amended as follows:

--2. (amended) A method according to claim 1, further comprising:

[•] starting said dry etching using a substance assisted plasma comprising at least one substance from the group [comprising] consisting of chemically inert and reactive gases, [such as nitrogen, hydrogen, argon and halogen compounds (e.g. Cl, Br, or I based compounds) and] hydrocarbon gases [(e.g. CH_4 and C_2H_6)], and mixtures of [them] chemically inert and reactive gases and hydrocarbon gases;

[•] passivating the facets after obtaining a contamination free surface by using a nitrogen assisted plasma.--

Claim 11 has been amended as follows:

--11. (amended) The method according to claim 1, wherein said GaAlAs-InGaAs surfaces at crystal mirror facets also comprise an element from the group [comprising] consisting of Sb and Se.--

Claim 12 has been amended as follows:

--12. (amended) The method according to claim 2, further comprising:

[•] starting to grow a nitride layer onto said contamination free surface during introduction of an element from the group [comprising] consisting of ionic nitrogen, atomic nitrogen and molecular nitrogen to said substance assisted plasma and in reaction with GaAlAs-InGaAs layers provided during said cleaving of said laser facets;

[•] making an interface between each cleaned facet and said grown nitride layer gradual making use of a native nitridisation in order to minimize interface recombination between different layers.--

Claim 13 has been amended as follows:

--13. (amended) A method according to claim 12, further comprising:

creating said nitride layer using plasma comprising nitrogen with an extracted beam, said [nitide] nitride layer consisting of at least one material from the group [comprising] consisting of AlN, GaN, InN, InAsN.--

Claim 23 has been amended as follows:

--23. (amended) A method according to claim 20, further comprising:

creating said nitride layer using plasma comprising nitrogen with an extracted beam, [.] said nitride layer consisting

of at least one material from the group [comprising] consisting of AlN, GaN, InN, InAsN.--

Claim 32 has been amended as follows:

--32. (amended) The method according to claim 26, wherein:

said mixture between said reactive gases and inert gases comprises at least one element from the group [comprising] consisting of argon, nitrogen, hydrogen and chlorine.--

Claim 33 has been amended as follows:

--33. (amended) The method according to claim 26, wherein said creation of a first nitrided surface layer uses a nitrogen ion beam extracted from a plasma containing nitrogen gas, said plasma comprising at least one element from the group [comprising] consisting of hydrogen and argon.--

Claim 35 has been amended as follows:

--35. (amended) A method to passivate a laser mirror comprising layers of GaAlAs-InGaAs after obtaining a first and a second contamination free laser mirror facet surface, comprising:

adding nitrogen gas to an argon plasma and gradually removing argon until only nitrogen plasma is provided [in a step like manner],

growing a nitride layer during introduction of the nitrogen onto and in reaction with said GaAlAs-InGaAs layers making the interface between said contamination free facet surface and said nitride layer gradual, said nitride layer

gradually making use of a native nitridisation in order to obtain a gradual border line between said layers.--